Diagnosing and controlling a campylobacter abortion outbreak in sheep

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Abstract

History: This reported outbreak is based on a sheep and beef, breeding and finishing unit in the Wairarapa region of the lower North Island. Abortions began 5 August 2015 in ewes that were due to lamb on 25 August that year.

Diagnostic testing: Campylobacter fetus subspecies fetus was cultured from the stomach contents of all four aborted foetuses that were sampled.

Recommended intervention: The farmer was advised to spread the ewes out over the farm and regularly remove aborted material from the paddocks to minimise the environmental challenge faced by susceptible animals.

Outcome: It was estimated that 13% of the flock had aborted by the start of lambing. This did not include ewes that aborted after the start of lambing as they were considered to be postnatal losses.

Clinical relevance: This case aims to act as an example of the factors to be considered in the approach to a campylobacter abortion outbreak investigation so that the best outcome can be achieved for the farmer. Interventions evaluated are: vaccination in the face of an outbreak, mass medication with antibiotics and the administration of an annual booster vaccine.

In this case ewes were not vaccinated in the face of the abortion outbreak to minimise the spread of campylobacter between yarded animals. This reasoning would be questioned by Gumbrell et al. (1996) who found a positive response to vaccinating ewes in the face of a campylobacter abortion outbreak; although it is questionable if the response described would have been seen in this case as the abortion outbreak was closer to the start of lambing than the study populations that were involved in Gumbrell et al. (1996). In this case a definitive diagnosis of campylobacter abortion was reached 22 days prior to the estimated median lambing date. When the immunological principles behind killed attenuated vaccines are considered, it is unlikely that a protective immunity would have developed prior to lambing in an abortion outbreak this late in gestation (Siegrist 2008).

Another possible intervention to consider in an abortion outbreak is the mass medication of ewes with antibiotics. Reported investigations into this option (Hicks 2002) have been unrewarding although they would suggest a better response would be seen in our case because of the early detection and intervention.

It is well-known in the sheep industry to only vaccinate maiden ewes and not to boost the vaccine in subsequent years. This appears to be effective as long as the challenge isn’t too great, such as in high stock density situations or if the whole flock is not vaccinated (West et al. 2009, Mannering et al. 2003).
Introduction

Campylobacter abortion in sheep is primarily caused by the bacterium *Campylobacter fetus* subspecies *fetus* (West et al. 2009). There are a number of strain types of *C. fetus fetus* maintained in New Zealand sheep flocks. The commercial vaccines available have been proven to be cross protective against the different strain types (Mannering et al. 2003) and are widely used in preventative schemes.

Campylobacter can be transmitted by contaminated feed, water or by direct contact with aborted material (West et al. 2009). The black backed gull (*Larus dominicanus*) is thought to be associated with the spread of disease as they are reported to scavenge in lamb paddocks, acting as a mechanical vector (West et al. 2009).

Campylobacter typically causes early neonatal losses and abortions in the last six weeks of pregnancy. Campylobacter abortions will usually affect maiden ewes; this occurs because ewes become immune following an abortion event, preventing abortions in subsequent years (West et al. 2009). Infection with *C. fetus fetus* causes a bacteraemia with a subsequent placentitis leading to abortion 7–25 days after infection (West et al. 2009). Following infection a proportion of animals maintain a population of *C. fetus fetus* in their small intestine, which is thought to allow campylobacter to persist from year to year (West et al. 2009).

A seroprevalence survey performed by Dempster et al. (2010) found that up to 88% of New Zealand sheep flocks have been exposed to *C. fetus fetus*. In a campylobacter abortion outbreak it is typical for 5–10% of ewes to abort, although up to 20% has been recorded (Gumbrell et al. 1982).

Clinical findings

The investigated abortion outbreak occurred on a sheep and beef farm located in the Wairarapa region of the lower North Island. The farm consisted of 1,113 hectares of rolling hill country split into two blocks. Block one was stocked with about 2000 ewes, 850 hoggets, 230 in calf cows, 110 R2 heifers, 80 R2 steers and 215 weaners. Block two was stocked with 1300 ewes. Abortions occurred exclusively on block one. The only stock sourced off farm were breeding bulls and rams. All replacements were bred on farm as part of breeding and finishing system. Perendale was the predominant sheep breed used on this farm. Mating occurred over a 54-day period.

Over winter, ewes are on a long rotation grazing pasture. The ewes were managed in mobs ranging from 500–1000 in each mob.

Ewes were first lambed as two-tooths. Over lambing the two-tooths were managed separately; with exception to the ‘late’ singles that were lambed with the mixed age ewes for convenience. One thousand, three hundred ‘early ewes’ were due to start lambing on 1 August on block two. The ‘main mob’ of ewes were due to start lambing on 25 August on block one. Prior to lambing ewes were ‘spread out’ across the farm. Twining ewes were stocked at about 160 ewes per paddock and singles had about 280 ewes per paddock, however this was paddock size dependent and may have varied.

On 5 August the farm manager noticed 6–10 aborted foetuses amongst the main mob
of ewes. The ewes that aborted did not show any signs of systemic illness and no other problems were noted amongst the mob. Initially the outbreak began in the mixed-age ewes but as the outbreak progressed, all age groups were affected.

Ewes weren’t vaccinated for the common causes of abortion such as campylobacter, toxoplasmosis or salmonella.

A veterinary visit was arranged for 5 August.

Initial clinical examination – No ewes appeared ill on a distance examination so a physical examination was not performed.

Post mortems were carried out on four aborted lambs collected fresh from the paddock. The placenta appeared to be thickened and had an increased opacity. No abnormalities were noted externally. When the foetuses were cut open a large amount of serosanguinous subcutaneous oedema was noticed. Findings such as consolidated lungs and ‘slippers’ still covering the hoofs confirmed that the lambs were born dead. There were no changes or abnormalities noted in other organs.

Fresh stomach content and heart blood was submitted to the lab along with fixed brain, lung, liver, kidney, heart, thyroid, and cotyledons. \textit{C. fetus fetus} was cultured from the stomach contents of all four lambs. Histology on fixed tissue was consistent with systemic foetal inflammation and a bacterial cause of abortion.

Diagnosis/confirmation of diagnosis – The three main differentials were campylobacter, salmonella and toxoplasmosis. Other possible differentials could have been the less common causes of abortion such as border disease or neospora.

The clinical picture in this case supported campylobacter as the inciting cause for this abortion outbreak. Campylobacter will typically cause abortion in the last third of gestation without systemic illness in the ewe, which is consistent with this case. The post-mortem findings were unspecific but the samples taken were able to confirm the diagnosis of campylobacter as the cause of this abortion outbreak.

Treatments – The farmer was advised to spread affected ewes out and remove ewes that had aborted from the main flock, along with all aborted material.

The farmer was advised to put a vaccination protocol in place for the following breeding season. The suggested protocol was: a booster and a sensitiser vaccine dose prior to mating 4–6 weeks apart, given to all breeding stock in the first year. This vaccination was to be boosted annually with only maiden ewes receiving a sensitiser and booster dose thereafter.

Outcome – Between 5 August and the start of lambing an estimated 400 lamb foetuses were aborted. Assuming a 160% scanning rate, this would equate to about 250 ewes aborting (12.5\% of the at risk group). This estimate is on the conservative side as ewes that aborted after the start of lambing were not included in this estimate and were instead attributed to post-natal losses.

The 2015 season showed an 11\% and 9\% increase in lambing percent when compared to the 2013 and 2014 season respectively. The 2015 season had similar lamb losses (scanning % - tailing %/ scanning %) as the 2013 season of 16\% and 18\% respectively. The 2014 season had significantly more lamb loses of 23\%. 
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Table 1. Reproductive history of the farm

<table>
<thead>
<tr>
<th>Age group</th>
<th>No. in age group</th>
<th>2013 season</th>
<th>2014 season</th>
<th>2015 season</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Lambing %</td>
<td>Lamb %</td>
<td>Lamb %</td>
</tr>
<tr>
<td>Two-</td>
<td>500</td>
<td>134</td>
<td>108</td>
<td>19</td>
</tr>
<tr>
<td>MA</td>
<td>1430</td>
<td>151</td>
<td>126</td>
<td>17</td>
</tr>
<tr>
<td>Total</td>
<td>1930</td>
<td>147</td>
<td>121</td>
<td>18</td>
</tr>
</tbody>
</table>

Discussion

Material on the packet of the common campylobacter vaccines suggests a 9% increase in lambing percent in response to vaccination. This is based on a study performed by Anderson (2001). Anderson (2001) attributes the response in lambing percentage to the elimination of subclinical post-natal losses caused by campylobacter infection. This raises the question of whether or not there will be any response to vaccination in this case, as the age distribution of the abortion outbreak would suggest there has been little exposure and subsequent immunity to C. fetus fetus. There is an 11% increase in lambing percent when the 2015 and 2014 results are compared. This increase could be explained by the 10% increase in scanning percent and not the benefit of vaccination. This highlights the reliability of comparing results between different years as it does not control for possible confounding effects such as seasonal variation, ewe condition, management factors and weather over lambing, making the exact response to vaccination difficult to establish.

The flock was not vaccinated in the face of the abortion outbreak because it was thought yarding ewes would assist and increase the spread of campylobacter, however this could be disputed as a study by Gumbrell et al. (1996) found that vaccination could be beneficial. Their study showed that vaccination in the face of an outbreak decreased the total amount of abortions by up to one half. The only time the author did not find a positive response to vaccination was when the farmer took two weeks to respond to the abortion outbreak (Gumbrell et al. 1996).

The response to vaccination reported by Gumbrell et al. (1996) may not have been consistent in this case, as this abortion outbreak was four weeks closer to the start of lambing than the groups studied. The campylobacter vaccines available are killed attenuated vaccines, which require a sensitiser and booster dose 10–14 days apart (West et al. 2009). After the ‘sensitiser’ dose the IgG titres are slow to peak, small and wane relatively quickly (Siegrist 2008). The ‘booster’ dose reactivates immune memory cells, resulting in a rapid increase of IgG titres, which will peak seven days after vaccination (Siegrist 2008). Campylobacter was confirmed 15 days prior to the start of lambing and 22 days prior to the estimated median lambing date in this case. This would indicate that by the time a vaccination protocol was implemented, the majority of susceptible ewes would not develop a protective immune response prior to lambing. Vaccination could instead have negative implications such as increased risk of metabolic disease caused by yarding ewes (West et al. 2009) and the use of a gram-negative vaccine (Kim Kelly, personal comment). Yarding ewes will also increase the spread of C. fetus fetus between susceptible animals.
Campylobacter has a long incubation period of 7–25 days (West et al. 2009), so it is safe to assume a large proportion of ewes were already infected by the time abortions became evident; especially when you consider the acute nature of this abortion outbreak. As discussed previously a protective immunity to campylobacter will only develop seven days after the ‘booster’ vaccine dose is given; which means a protective immunity would not have developed within the incubation period of campylobacter and vaccination will therefore not protect incubating animals.

Hicks (2002) suggest that mass medication of affected flocks with injectable oxytetracycline antibiotics could be clinically and economically significant in a campylobacter abortion outbreak. Although this paper was not conclusive, as a clear response was not seen in their case, Hicks (2002) suggested that because of early intervention in the case described here, we would have seen better results than described in their study. Antibiotic use has also been shown beneficial by Hilson et al. (2015) in a different bacterial cause of abortion, listeria. Hilson et al. (2015) found that groups treated twice with Intracillin LA or Depocillin had 44% less abortions than the non-treated group. Treatment was estimated to cost $2.30 per ewe. In our case this would have cost $4,600, making a 2.8% decrease in abortion rate required to break even; which, if we extrapolate from the Hilson et al. (2015) case involving listeria, seems likely. The use of infeed antibiotic treatments was investigated by Hicks (2002) and found to be unrewarding as ewes had high rates of metabolic disease caused by palatability issues and interference with rumen microflora.

It is well known in the sheep industry to only vaccinate maiden ewes and not boost the vaccine in subsequent years. This appears to be effective as long as the challenge isn’t too great, such as in high stocking density situations or if the whole flock is not vaccinated (West et al. 2009, Mannering et al. 2003). This could be an area for concern in this case as ewes are rotationally grazed throughout the winter at high stocking densities. It is hard to quantify if the grazing system on this farm will cause a vaccine breakdown without annual vaccine boosting, but because of the low number of vaccine breakdowns reported, it seems unlikely.

Not vaccinating mixed age ewes will save $2,409 per year if the quoted vaccine price stays the same at $0.73 per animal. The worst abortion rate in a vaccine breakdown case was quoted by Mannering et al. (2002) as 3.6%. A 3.6% abortion rate equates to a potential loss of 119 lambs on this farm. This represents a potential lost profit of $9,520 (assuming a profit of $80 is made on each lamb raised). Four consecutive years without a vaccine breakdown is required to make the decision of not boosting the vaccine annually cost effective. This is an approximation based on the assumption that a vaccine breakdown will have a lower abortion rate than in a naive flock.

Conclusions

When approaching a campylobacter, case timing should be considered when deciding if vaccination would be beneficial. For a vaccine course to be effective it requires at least seven days after the booster dose before a protective immunity will develop. Without the development of a protective immunity vaccination is likely have an only negative impact.
The attending veterinarian should also consider and be open to the possible benefits of antibiotic use especially in severe cases, such as this case. Severity cannot be predicted prior to an abortion outbreak and will most likely be defined retrospectively making this intervention a difficult decision.

Boosting the campylobacter vaccine annually may not be economically significant and should be discussed with the farmer to see how risk adverse they are and their ability to cope with the possible consequences of a vaccine breakdown.

References


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